Claims:

1. A method for producing a quantum-sized material according to a predetermined, two-dimensional nano-porous polymer template, the method comprising the steps of:

(A) preparing said nano-porous polymer template, wherein said preparation step comprises the sub-steps of (i) dissolving a polymer in a volatile solvent to form an evaporative solution, (ii) depositing a thin film of said solution onto a substrate, and (iii) exposing said solution film to a moisture environment while allowing the solvent of said solution to evaporate for forming said template which is constituted of an ordered array of nanometer-scaled air bubbles with polymeric walls dispersed in a polymer film;

(B) filling said air bubbles with a precursor fluid; and

(C) converting said precursor fluid in said bubbles to obtain a quantum-sized material in the form of an array of dots supported in said template, wherein at least one of the dot dimensions is on the 100 nm scale or smaller.

2. The method of claim **1**, wherein said precursor fluid comprises a capping agent and/or a passivating agent.

3. The method of claim **1**, further comprising a step of removing said polymeric walls to recover said quantum-sized material in a powder form.

4. The method of claim **1**, wherein said quantum-sized material is physically entrapped in said air bubbles and/or chemically bonded thereto.

5. The method of claim **1**, further comprising a step of re-melting and re-solidifying said polymeric walls to consolidate said polymer film.

6. The method of claim **1**, wherein said precursor fluid is selected in such a fashion that said quantum-sized material is a material selected from the group consisting of (i) group I-VII semiconductors, (ii) group II-VI semiconductors, (iii) group III-V semiconductors, (iv) group IV

semiconductors, (v) metals, (vi) metal oxides, or a combination thereof.

7. The method of claim **6**, wherein the group I-VII semiconductors are selected from the group consisting of CuCl, AgBr, and NaCl.

8. The method of claim **6**, wherein the group II-VI semiconductors are selected from the group consisting of ZnO, ZnS, ZnSe, ZnTe, CdS, CdSe, CdTe, HgS, HgSe, HgTe, and alloys of these materials.

9. The method of claim **6**, wherein the group III-V semiconductors are selected from the group consisting of GaP, GaAs, InP, InAs, InSn, and alloys of these materials.

10. The method of claim **6**, wherein the group IV semiconductors are selected from the group consisting of C, Si, Ge, and alloys of these materials.

11. The method of claim **6**, wherein the metals are selected from the group consisting of Ni, Cu, Ag, Pt, and Au.

12. The method of claim **6**, wherein the metal oxides are selected from the group consisting of silica, titania, alumina, and zirconia.

13. The method of claim **1**, further comprising a step of:

(D) removing the polymeric walls, such that a plurality of voids are formed in the quantum-sized material in positions which were occupied by said polymeric walls prior to the removal of said polymeric walls, wherein the quantum-sized material is self-supporting.

14. The method of claim **13** wherein step (D) includes the sub-step of immersing the template in a polymeric wall-selective etchant or solvent.

15. The method of claim **13**, further comprising the step of:

(E) refilling the voids with a supporting material.

16. The method of claim **15**, wherein the supporting material has an index of refraction that is lower than that of the dots.

17. The method of claim **1**, wherein said precursor fluid comprises colloidal nanocrystals dispersed in at least one solvent which is unreactive with respect to the polymeric walls.

18. The method of claim **17**, wherein step (C) comprises removing said solvent such that the nanocrystals are concentrated as close-packed nanocrystals or quantum dots in the template.

19. The method of claim **18**, wherein the proportions of the colloidal nanocrystals and the at least one solvent are selected so that there is sufficient quantity of nanocrystals to completely fill in the pores after step (C) is performed.

20. The method of claim **17**, wherein step (B) further includes the sub-step of adding a surface capping agent to the at least one solvent in which the nanocrystals are dispersed, whereby the colloidal nanocrystals are stabilized by the surface capping agent in the at least one solvent, and the colloidal nanocrystals are prevented from agglomerating.

21. The method of claim **17**, wherein step (B) further includes the sub-step of adding a surface passivating agent to the at least one solvent in which the nanocrystals are dispersed, whereby the colloidal nanocrystals are passivated to promote optical or electro-luminescence properties of the quantum-sized material.

22. The method of claim **1**, wherein sub-step (A-iii) is performed by directing a moisture-containing gas to flow over said solution film while allowing the solvent of said solution to evaporate for forming said template.

23. A quantum-sized material patterned according to a predetermined, two-dimensional template, produced according to the method of claim **1**.

24. A quantum-sized material patterned according to a predetermined, two-dimensional template, produced according to the method of claim **15**.

25. A quantum-sized material patterned according to a predetermined, two-dimensional template, produced according to the method of claim **17**.